PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Process and Apparatus for the Recovery of Solvents on long Webs

I, PETRUS VIAL, a French Citizen, of 51, Avenue de Saxe a Lyon—(Rhone), France, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention has for its object a process for the continuous drying of a long web coated with a varnish or the like dissolved in a volatile solvent. The invention more particularly refers to the case of paper or fabric bands used for insulating purpose in the electrical industry. Such webs are coated on one face or on both with an alcoholic solution of an appropriate varnish, the solvent is evaporated and the varnish is hardened or set under the action of heat and pressure.

A considerable quantity of solvent has thus to be evaporated and the vapours have to be recovered since this solvent is generally expensive and often noxious.

It is further known to dry a band, strip or ribbon carrying a volatile solvent by passing the band or the like through one or several substantially air-tight drying heated chambers through which air or other drying gas is circulated and is thereafter conveyed to a separating device in which the solvent is recovered, such device being generally in the form of a cooled condenser. The air or other gas from which the solvent has been recovered may be discharged into the atmosphere or it may be re-heated and re-circulated through the drying chamber or chambers. It is thus possible to avoid any loss of solvent, but the presence of air or other gas in the drying chamber or chambers reduces the partial pressure of the solvent vapour within the said chamber or chambers whereby the evaporation of solvent from the band is correspondingly reduced.

According to this invention a long web coated with a varnish or the like dissolved in a volatile solvent is continuously dried by being passed through a heated atmosphere of the solvent vapour, which atmosphere is continuously subjected to condensing action, the said atmosphere being at a pressure slightly above the outer atmospheric pressure and substantially free of air or other gas.

The heated atmosphere and condensing zone thus being connected with one another form a closed unit into which air cannot penetrate. The solvent vapour may therefore directly pass from the heated atmosphere into the condensing zone without being hindered by the presence of air.

The pressure of the heated atmosphere is preferably adjusted by introducing into it a controlled quantity of vapour of the solvent.

The web is preferably not completely dried within the heated atmosphere and the residual solvent which it carries is subsequently evaporated by hot air. There is thus obtained a complete drying of the web in an atmosphere of relatively small volume, while the evaporation of the residual solvent within the heated atmosphere only would require a much more cumbersome apparatus. Moreover it has been observed that the vapours from the residual solvent generally contain impurities which are detrimental to the quality of the solvent recovered, such impurities being evolved by the varnish itself when it is almost dry.

The invention also has for its object an apparatus for carrying into practice the above process, such apparatus comprising a drier divided into two chambers through which the band is passed; sealing devices for reducing leakage of solvent vapour at the inlet and outlet orifices for the band into and from the first chamber; heating devices in both chambers; air circulating means in the second chamber, and a cooled condenser connected with the first chamber. This

apparatus may besides comprise an electrically heated evaporator or boiler connected with the first chamber, and a blower for forcing the air and vapour from the first chamber into the condenser when the apparatus is started and when air has not yet been eliminated therefrom. The condenser may be divided into a number of separate elements which may be put separately into operation in order to adjust the condensing power to the rate of evaporation of the solvent within the first chamber.

The apparatus according to the invention preferably comprises means for deriving vapour from the first chamber in the vicinity of the connection thereof with the condenser and for forcing this vapour towards the inlet and/or outlet orifices for the band into and/or from the first chamber in order to maintain a slight overpressure in the vicinity of these orifices.

In the annexed drawing:

Fig. 1 is a general diagrammatical view of an apparatus according to this invention.

Fig. 2 is a large scale section of the inlet or outlet seal for the band into or from the first chamber of the drier.

The apparatus illustrated comprises an inverted U-shaped drier 1. The band 2 to be dried enters vertically this drier at the left lower end thereof, it passes over a roller 3, is led horizontally towards a second roller 4 from which it runs downwardly and leaves the drier at the right-hand lower end thereof. The drier is divided into two chambers 6 and 7 by a horizontal partition 5 disposed somewhat above the outlet of the band 2 from the drier, the first chamber 6 being thus much more important that the second chamber 7 which only occupies a portion of the right branch of the U.

The band 2 enters the chamber 6 through a seal comprising two series of thin horizontal plates 8 (fig. 2) disposed above each other in relatively close formation on each side of the band 2 and at a very small distance thereof, such distance being adjustable, if necessary. The plates 8 thus form a labyrinth seal which, although it is not perfectly gas-tight, considerably reduces vapour leakage from the chamber 6. A similar sealing device is provided in the partition 5 for the passage of the band 2 therethrough. Chambers 6 and 7 are provided with appropriate heating devices such as infra-red electric bulbs 9.

The upper zone of the drier 1 is connected by a pipe 10 with a condenser 11 disposed within a tank 12 through which cold water is circulated, this condenser being provided with a lower outlet pipe 13 which also forms an air outlet when the apparatus is started. As illustrated, the pipe 10 opens on the side of the drier in order to communicate freely with the space disposed above the band 2 as well as with the space disposed below the same. The pipe 10 is connected by means of a branch pipe 14 with the inlet of a centrifugal blower 16, the outlet of this blower being connected by a pipe 17 with the left-hand lower end of the drier in the immediate vicinity of the inlet of band 2 thereinto.

The pipe 10 is provided with a butterfly valve 32 and the latter is by-passed by a circuit comprising a short pipe 18 communicating with the inlet of a centrifugal blower 19 and another pipe 20 extending from the outlet of this blower, the said pipe 20 being itself provided with a butterfly valve 21.

The pipe 10 is connected by means of a pipe 22 with an evaporator or boiler 23 in which there is disposed an electric heating element 24. This evaporator 23 is connected with a constant level device 25 by means of which it is fed with the liquid solvent used for varnishing the band.

The upper part of the second chamber 7 is provided with an exhaust pipe 26 which may be connected to a chimney or to the inlet of a blower. The outlet slit provided at the lower end of the said chamber 7 for the outlet of the band 2 has no sealing device and is arranged to permit a substantial inlet of air into the said chamber 7.

The apparatus described operates as follows:

It will be supposed that the band 2 is a paper band coated with a varnish in alcoholic solution. This band 2 enters the drier 1 immediately after being coated. It is submitted within the first chamber 6 to the action of the heating bulbs 9 which cause evaporation of the solvent. The alcoholic vapours flow into the condenser 11 through the pipe 10 with the air which was contained within the apparatus, this air exhausting progressively through the pipe 13 at the bottom of the condenser. When the alcoholic vapours reach the condenser 11 they are condensed and the liquid solvent thus recovered flows through the said pipe 13. The band 2, almost completely dried, passes from the first chamber 6 into the second chamber 7 wherein the small residual quantity of solvent still retained by the band is finally evaporated in the hot air which circulates through the said chamber under the action of the suction created by the pipe 26.

The apparatus is so adjusted that during normal running the pressure of the solvent vapour within the drier 1 is very slightly higher than the outer atmospheric pressure. Under these conditions no inlet of air takes place either through the labyrinth seals for the band or through the pipe 30 itself. In order to ensure this overpressure in the lower portion of the chamber 6 in spite of the cooling effect produced by the ingress of the cold band, the blower 16 continually delivers into this zone hot vapours from the upper part of the drier. This draft of hot vapours, besides, helps to obtain a quick superficial heating of the band.

The exact adjustment of the vapour pressure within the drier 1 is somewhat delicate since it is dependent on a large number of conditions. In accordance with the invention in order to facilitate this adjustment the condenser 11 is preferably arranged for obtaining a vapour pressure lower than the atmospheric pressure, and this excessive condensing power of the condenser is corrected by introducing into the apparatus an appropriate quantity of alcohol vapour by means of the evaporator or boiler 23 which is heated by the heating element 24. When the latter is in operation the alcohol contained in the evaporator or boiler 23 boils, and the vapour produced flows through pipes 23 and 10 into the first chamber thus increasing the load on the condenser and causing an increase of pressure within the drier. By thus acting on the heating element 24 it is possible to obtain a safe and quick adjustment of the pressure within the drier, whereas the adjustment which could be obtained by means of the heating bulbs 9 or by controlling the flow of cooling water through the tank 12 would be too slow in action.

It will be noted that the liquid level within the evaporator or boiler 23 is equal to the liquid level in the constant level device 25 minus an alcohol head corresponding to the overpressure within the drier. But since this overpressure is very small and practically constant the device 25 may be easily adjusted for maintaining a given quantity of alcohol in the chamber 23.

The heating element 24 may be controlled by a temperature or by a pressure responsive switch appropriately disposed.

The condenser 11 is preferably divided into a number of elements which may be individually connected with the pipe 10 in such a manner that the condensing power may be selected in accordance with the requirements, i.e. with the importance of the flow of vapour from the first chamber. It will be understood that if the auxiliary evaporator or boiler 23, 24 were not provided the condensing power of the condenser would then correspond to a limited number of combinations. Owing to the auxiliary evaporator or boiler the condensing power may be varied at will within rather wide limit for each number of condensing elements in operation.

The apparatus permits of recovering alcohol from bands of small width by only using a limited number of condensing elements.

It is further to be remarked that the last residual quantity of alcohol carried by the band is only evaporated in the auxiliary chamber 7 by means of the hot air circulating therethrough. It is to be understood that under the action of suction from the pipe 26 air is caused to enter the chamber 7 through the clearance between the band 2 and the edges of the outlet slit provided for this band. This air is heated by the bulbs 9 and carries the last vapours of alcohol from the band. When an alcoholic insulating varnish is dried, the alcohol vapours generally contain other volatile products such as formaldehyde, phenol, etc. which are detrimental to the alcohol recovered. It has been noted that these volatile impurities only appear when the varnish is almost dried. By effecting the final drying of the band within the auxiliary chamber 7 these volatile products are carried away by the hot air and thus eliminated. Moreover the second chamber 7 is far less cumbersome than the additional volume which would have to be provided for the first chamber 6 if the latter had to ensure the complete drying of the band. The loss of alcohol resulting from the operation of the second chamber 7 is practically negligible.

The centrifugal blower 19 is used for starting the apparatus when the latter is still filled with air. The valve 32 is closed while the valve 21 is opened. The air and alcoholic vapours are thus positively forced by the blower 19 into the condenser 11. When the air has been evacuated the blower may be stopped and the butterfly valve 32 re-opened.

The apparatus may also comprise a by-pass 27—28 inserted between the pipes 10 and 14; such by-pass comprising a box 29 adapted to receive smoke producing agents. Valves 30—31 permit of causing the air sucked by the blower 16 to pass through the box 29. When the air tightness of the apparatus is to be tested the box 29 is put into operation and any leak is easily detected by the appearance of smoke.

What I claim is:—

1. A process for the continuous drying of long webs coated with a varnish or the like dissolved in a volatile solvent, wherein the web is passed through a heated atmosphere of the solvent vapour which atmosphere is continuously subjected to condensing action, the said atmosphere being at a pressure slightly above the outer atmospheric pressure and substantially free of air or other gas.

2. A process as claimed in claim 1, wherein the pressure of the heated atmosphere is adjusted by introducing thereinto a controlled quantity of the solvent vapour.

3. A process as claimed in claim 1, wherein the web is not completely dried within the heated atmosphere of the solvent vapour, the residual solvent which it carries being subsequently evaporated by hot air.

4. Apparatus for carrying into practice the process claimed in claim 3, comprising a drier divided into two successive chambers through which the web is passed, sealing devices for reducing vapour leakage at the inlet and outlet orifices for the web into and from the first chamber, heating devices in both chambers, air-circulating means in the second chamber, and a cooled condenser connected with the first chamber.

5. Apparatus as claimed in claim 4, wherein the sealing devices comprise a number of plates disposed close to each other in the immediate vicinity of the web to form a labyrinth seal therewith.

6. Apparatus as claimed in either of claims 4 and 5, comprising means for deriving vapour from the first chamber in the vicinity of the connection thereof with the condenser and for forcing this vapour towards the inlet and/or outlet orifices for the band into and/or from the first chamber.

7. Apparatus as claimed in any of claims 4 to 6, comprising an electrically heated evaporator or boiler connected with the first chamber.

8. Apparatus as claimed in any of claims 4 to 7, comprising a blower for forcing the air and vapour from the first chamber into the condenser.

9. Apparatus as claimed in any of claims 4 to 8, wherein the condenser is divided into a number of separate elements which may be put separately into operation.

10. A process for the continuous drying of a web coated with a varnish or the like in a volatile solvent, substantially as herein described.

11. Apparatus for the continuous drying of a web coated with a varnish or the like in a volatile solvent, substantially as herein described and as illustrated in the accompanying drawing.

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713,612 COMPLETE SPECIFICATION
1 SHEET
This drawing is a reproduction of the Original on a reduced scale.

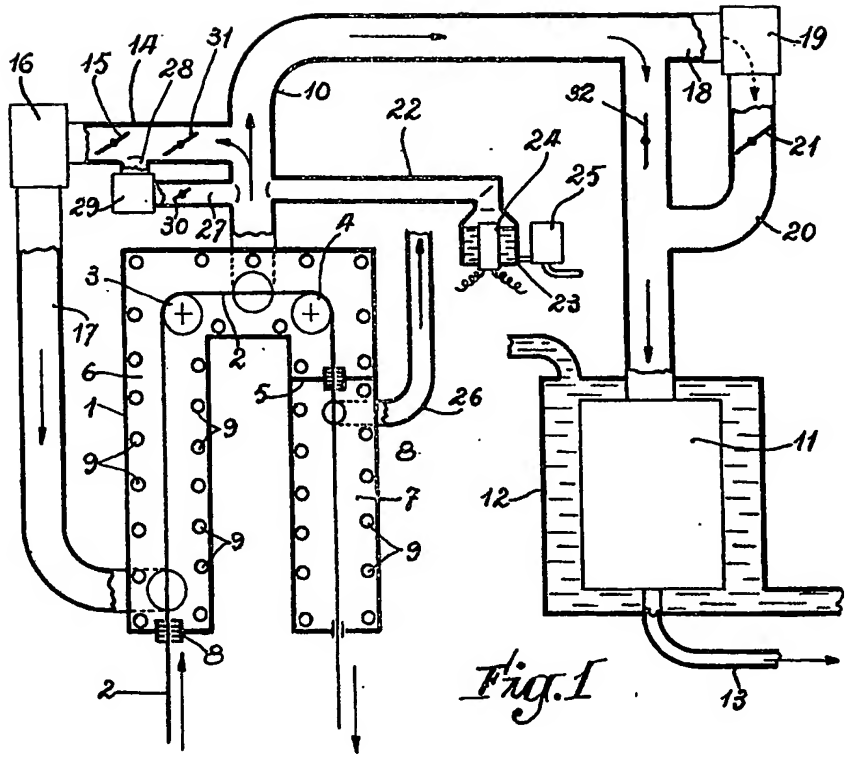

Fig. 1

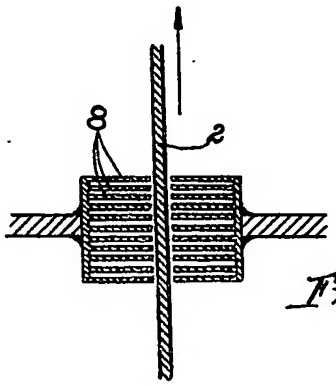

Fig. 2